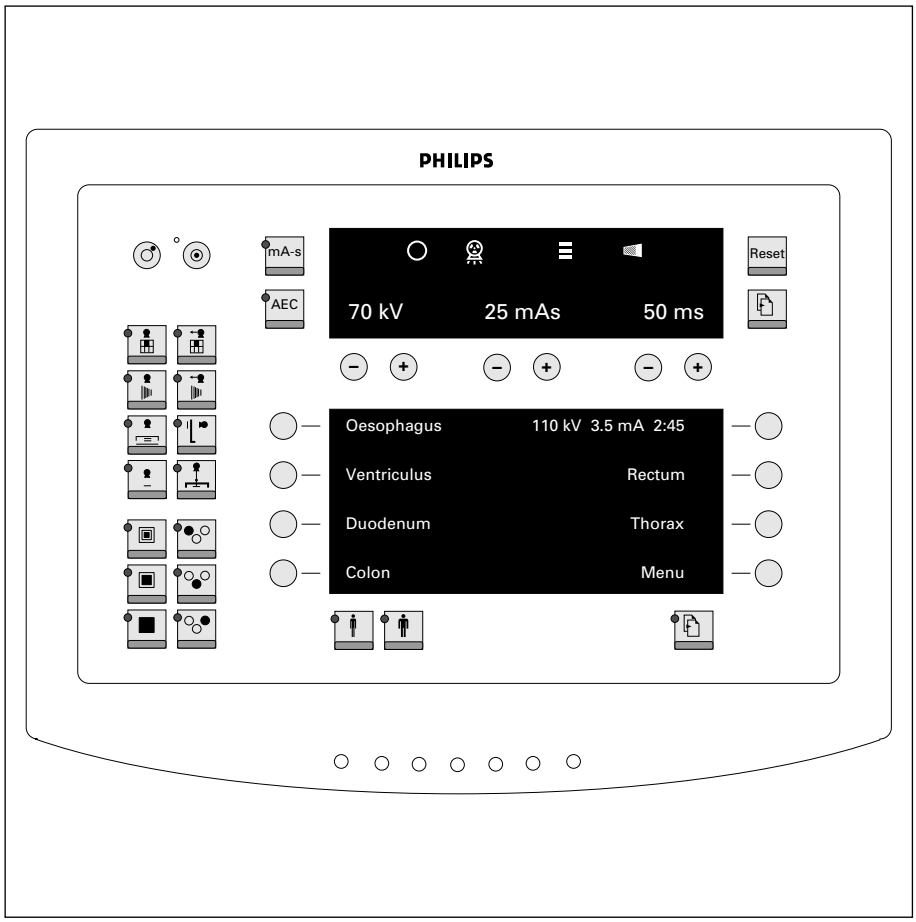
Radiography



INSTRUCTIONS FOR USE

Optimus 50/65/80

X-ray generator

Version 3.x

English

4512 987 13351/Rev.AA/742/2006-11

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1 Worth to know

1.1 The Optimus generators

The generators Optimus 50/65/80 are converter generators and controlled by microprocessors. The basic version contains an control desk and a standard housing with automatic control and high voltage generator. The control desk is available without automatic programmed radiography (APR) and automatic exposure control (AEC) as well as with APR and/or AEC.

1.2 Normal use

With the Optimus generators you can perform fluoroscopy and make diagnostic X-ray exposures within the scope of their technical data and descriptions.

1.3 For safe operation

- You must never use the X-ray equipment if it has any electrical, mechanical or radiation defects. This particularly applies to malfunctioning indication, warning and alarm devices.
- If the user wishes to connect the X-ray equipment to other equipment, components or assemblies and if it is not apparent from the technical data whether it can be safely combined with such equipment, components or assemblies, the user must ensure that the safety of the patient, operating staff and the environment is not affected by the planned combination by consulting the manufacturers involved or by making enquiries from an expert.
- Philips is responsible for the safety features of its products only if maintenance, repairs and modifications have been performed by Philips or by persons explicitly authorised to do so by Philips.
- As with any technical appliance, this equipment requires not only correct operation but also regular, competent maintenance and care, which are described in the section ”Maintenance“.
- If you operate the X-ray equipment incorrectly or if the user fails to have maintenance carried out properly, Philips cannot be held liable for any malfunctions, damage or injuries.
- Safety circuits must be neither removed nor modified.
- You may remove or open parts of the housing only if you are instructed to do so in this manual.

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1.4 Conformity

This Medical Device meets the provisions of the Medical Device Directive MDD 93/42 EEC (93).
If you have further questions regarding the applicable national or international standards, please address them to:

Philips Medical Systems DMC GmbH
Quality Assurance Department
Roentgenstrasse 24
D-22335 Hamburg
Fax: (+49) 40/5078-2147

1.5 Training

The X-ray equipment may only be operated by persons who have the necessary expertise in radiation protection or knowledge of radiation protection and who have been instructed in how to operate the X-ray equipment.

1.6 Other Instructions for Use

This X-ray generator is part of a system. The other system components are described in seperate manuals.

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2 Safety

2.1 About this manual

This manual is intended to enable you to work safely with the X-ray equipment described. You may only use this equipment in compliance with the safety instructions in this manual and not for purposes other than those for which it is intended.

It is always the user who is responsible for complying with the regulations which apply to the setting up and operation of X-ray equipment.

2.2 Electrical safety

This X-ray equipment meets the safety class I and type B according to IEC 60601-1.

Only trained maintenance staff may remove the covers from the high-voltage cable of the X-ray tube assembly and the high-voltage generator.

This X-ray equipment may only be operated in medical rooms which meet IEC requirements.

- ***You must never operate this X-ray equipment in areas where there is a risk of explosion.***
- ***Detergents and disinfectants, including those used on patients, may create explosive mixtures of gases. Please observe the relevant regulations.***

2.3 Electromagnetic compatibility (EMC)

In accordance with its intended use, this electronic apparatus complies with the law governing EMC, which defines the permitted emission levels from electronic equipment and its required immunity against electromagnetic fields.

Nevertheless, it is not possible to exclude with absolute certainty the possibility that radio signals from high-frequency transmitters, e.g. mobile phones or similar mobile radio equipment, which themselves conform to the EMC regulations, may influence the proper functioning of electromedical apparatus if such equipment is operated in close proximity and with relatively high transmitting power. Therefore, operation of such radio equipment in the immediate vicinity of electronically controlled medical apparatus should be avoided to eliminate any risk of interference.

Explanation:
Electronic apparatus that satisfies the EMC requirements is designed so that under normal conditions there is no risk of malfunction caused by electromagnetic interference. However, in the case of radio signals from high-fre-

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quency transmitters with a relatively high transmitting power, the risk of electromagnetic incompatibility when operated in close proximity to electronic apparatus cannot be totally ruled out.

In unusual circumstances unintended functions of the apparatus could be initiated, possibly giving rise to undesirable risks for the patient or user.

For this reason, all kinds of transmission with mobile radio equipment should be avoided. This also applies when the apparatus is in ”standby“ mode.
Mobile telephones must be **switched off** in designated problem zones.

2.4 Radiation protection

- ***Ensure that before performing any radiography all the necessary radiation precautions have been taken. Information about radiation protection you can find in the different Instructions for Use for the X-ray equipment used with this generator.***
- ***Safety circuits which may prevent X-radiation from being switched on under certain conditions may be neither removed nor modified.***

2.5 Disposal

Take-back, proper disposal and recovery of the Medical Device take place in accordance with the European WEEE Directive (Waste Electrical and Electronic Equipment) and/or respective requirements of national legislation.

Philips manufactures state-of-the-art X-ray equipment in terms of safety and environmental protection. Assuming no parts of the system housing are opened and assuming the system is used properly there are no risks to persons or the environment.

To comply with regulations it is necessary to use materials which may be harmful to the environment and therefore have to be disposed of in a proper manner.

For this reason you must not dispose of the X-ray equipment together with industrial or domestic waste.

Philips
- supports you in disposing of the X-ray equipment described in a proper manner
- returns reusable parts to the production cycle via certified disposal companies and
- thus helps to reduce environmental pollution.

Consequently, do contact your Philips Service Organisation in full confidence.

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3 Function and description

3.1 The function

This generator produces the voltages and currents required for operating an X-ray tube and makes the supply voltages available for parts of the X-ray system as a whole.

3.1.1 What the generator is capable of

In the following table you can see what configurations offer what exposure techniques:

Radiography and fluoroscopy techniques	Configuration			
	Basic version without APR, AEC	with APR without AEC	with AEC without APR	with APR and AEC
kV technique	–	–	+	+
kV-mA technique	–	–	–	+
TDC	–	–	–	+
kV-mAs technique	+	+	+	+
kV-mAs-s technique	+	+	+	+
kV-mA-s technique	–	+	–	+
special exposures for therapy simulation	–	+[3]	–	+[3]
Fluoroscopy technique	+[1]	+[2]	+[1]	+[2]

+ possible
– impossible
[1] only one kV-mA characteristic possible
[2] Customer Service can assign different kV-mA characteristics to the various APRs
[3] Fluoroscopy must be available

3.1.2 Possible configurations:

- Basic version
- Also with AEC (Automatic Exposure Control, optional)
- Also with APR (Anatomically Programmed Radiography, optional)
- Also with AEC and APR (optional).

This Operator‘s Manual describes all configurations.

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3.1.3 Functions of the maximum configuration:

- Exposure techniques
  - APR with automatic exposure control (AEC)
  - APR without automatic exposure control
- Techniques with automatic exposure control (AEC)
  - kV technique
    - with maximum tube power according to the focal spot selected or
    - with fixed current within the adjustable values
    - tomography (TDC, Tomography Density Control))
- Techniques without automatic exposure control
  - kV-mAs technique
  - kV-mA-s technique
  - kV-mAs-s technique

3.1.4 Other functions

- Change exposure data of an APR program
  - for the next exposures (without saving)
  - with saving afterwards
- Save up to 1,000 APR programs
- Adapting the exposure data to the thickness of the patient's body
- Area dose product (optional, depends on system)
- Variofocus (optional)
  With the Variofocus function you can select a focal spot the properties of which are between the large and small focal spots. The ratio of the two focal spots is stated as a percentage of the small focal spot.
  "20% SF" means 20% weighted power of the small focal spot and 80% weighted power of the large focal spot.
  The Variofocus is set for each APR program during installation.

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3.1.5 What's new?

This Operator's Manual describes the generator with all possible functions at the time of going to press. Relevant for the functions available in the generator is the acquired or upgraded configuration. This Operator's Manual also describes all the earlier generator versions. The following table informs you about all possible functions.

Function	from version	Option
AEC (Automatic Exposure Control)	1	+
Automatic tomo time input	1	+[2]
APR (Anatomically Programmed Radiography)	1	+
APR extension	2	[2,5]
Display of area dose product	2	+[1]
Variofocus	2	+[2]
Display of the thermal state of tube assembly	2	+[4]
TDC (Tomography Density Control)	2	+[2,6]
kV technique with fixed current	2	+[2,6]
PDO (Patient Data Organizer)	2	+[3]
Fluoroscopy	3	
Special exposure for therapy simulation	3	+[2,7]
Photomultiplier adapter	3	+[6]

[1] compatibility depends on the system
[2] only with APR
[3] see Operator's Manual for PDO
[4] depending on the system and tube assembly
[5] always included (without control module)
[6] only with AEC
[7] only with fluoroscopy

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3.1.6 What you have to know before switching on

- Please observe the instructions on safety and maintenance.
- If a button
  - is lit: the function or the auxiliary is activated.
  - is not lit: the function or the auxiliary is deactivated.
- If you reach a limit, the display goes out briefly and reappears.
- If you change a value and this causes a change in the mAs value, for example, the new value will be indicated.
- If you wish to change a non-variable value, the value is retained, whilst the display goes out briefly and reappears.
- After the end of an exposure there is an audible signal and the actual exposure data appear for 25 s as a post-exposure display or until the next operator action only with AEC. With you can call up the post-exposure display again provided you have not released any new exposure.
- You can make up to three exposures a minute in any sequence. **When doing so it is absolutely essential that you observe the tube assembly status display and the information contained in the Instructions for Use delivered with the tube assembly.**
- If you attempt to make a fourth exposure within one minute, it will not be released. The generator prevents any further exposure for one minute.

Exceptions:
- There is no limitation to three exposures per minute
  - if you release fluoroscopy within one minute and before the fourth exposure at the latest or
  - in the serial mode.

For pediatric exposures please read the note in chapt. 3.2.1.

3.1.7 Monitoring system for conditions for shutting down radiography

The generator has a monitoring system which in the event of an error protects against uncontrolled radiation, within the scope of foreseeable possibilities. With radiography using automatic exposure control this monitoring system interrupts the radiation if any of the following conditions is met:

- Stage 1: If the mAs value has reached 9.5 times the mAs value of the type of exposure selected
- Stage 2: If after 10% of the maximum permissible exposure time at least 4% of the expected switch-off dose has not been reached
- Stage 3: If 600 mAs or 4 s has been reached. The value of 600 mAs can be set lower by the Customer Service.

If you change an APR program temporarily this will be displayed by an asterix „*" (see section 4.5.4).

Then the monitoring system has the following status:

Stage 1: not active

Stage 2: conditionally active – the exposure time of 10% changes to 400 ms (10% of max. exposure time AEC = 4000 ms)

Stage 3: always active

Reactivate stages 1 and 2:
A: Press again APR button to reset values on default

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or

B: Save overridden data as described below (see chapter 4.5.4).

In both cases the asterix disappears.

To adapt stages 1 and 2 to the overridden data (case B): insert and save the expected mAs value. For reference you will find an exposure table in the Appendix.

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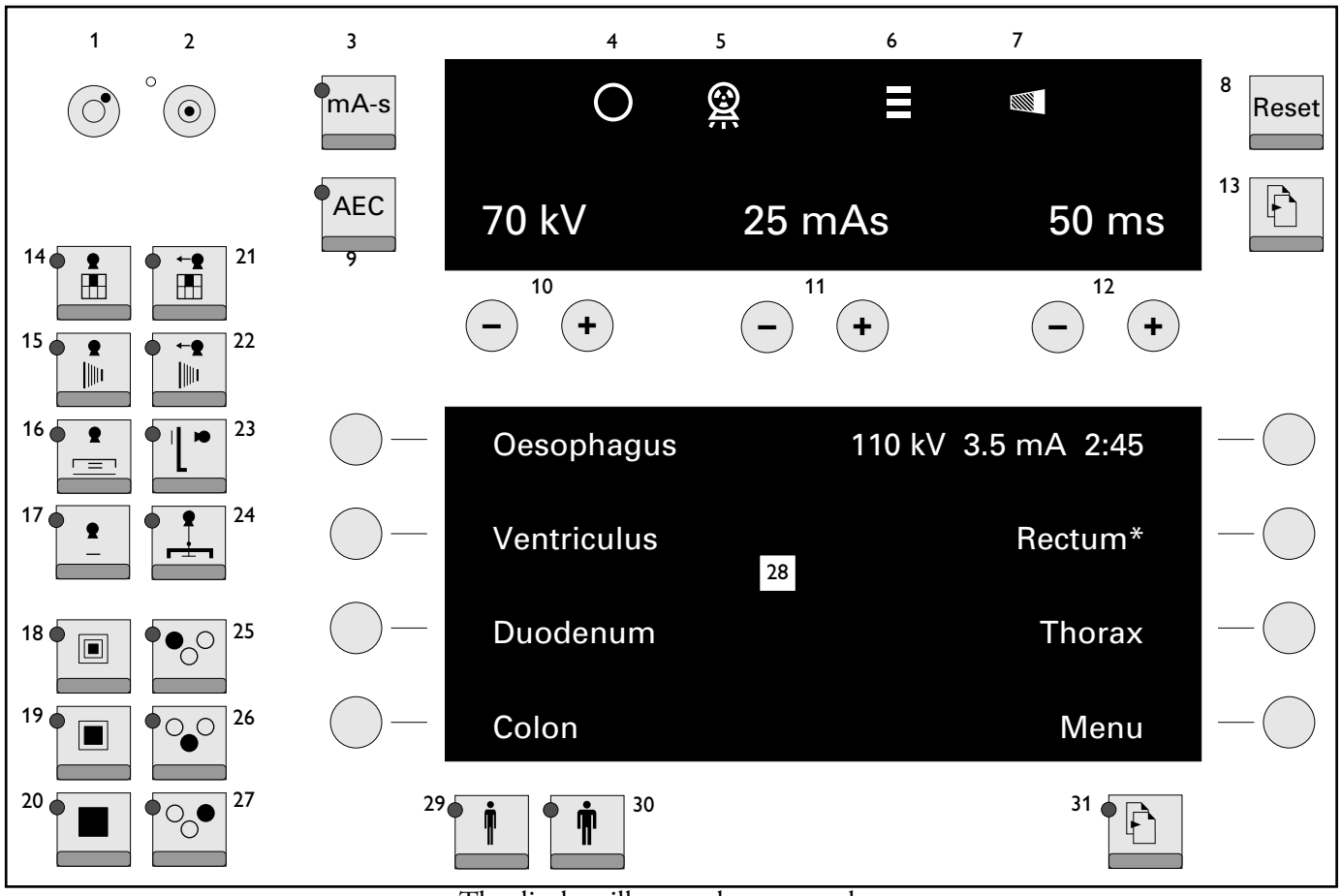
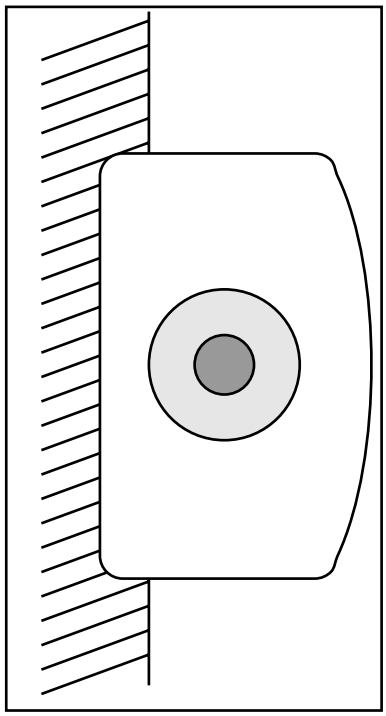
3.2 The control desk

3.2.1 Keys and displays – short and briefly



The displays illustrated are examples.



The exposure switch is a two-step switch.

Step 1:
Preparation – The green Ready indicator goes out.
When it lights up again:

Step 2:
Release exposure.

You can press the button straight through to the second position. After the preparation time the exposure is released. **Keep the button pressed until the end of exposure or else the exposure will be aborted. Never press the button more than three times in one minute. In this way you will extend the life of the X-ray tube.**

Specially for paediatric exposures and casualty departments, for example, Customer Service can program the preparation time to 30 s for each tube selected. Preparation remains on even after letting go of the exposure button from the ”Preparation“ stage, provided no exposure has been released. After exposure, preparation is switched off.

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No	Description
1	Switch off generator
2	Switch on generator
3	Select exposure technique
4	Ready for exposure
5	radiation is switched on
6	Display of the tube state
7	Incorrect exposure indicator
8	Reset functions
9	Switch on/off automatic exposure control
10	Selection and display of exposure voltage
11	Selection and display of exposure current
12	Selection and display of exposure time
13	Call up different levels
14	Spot film device
15	DSI
16	Angiography with Puck
17	Free cassette
18	Small focal sopt
19	Variofocus (optional)
20	Large focal sopt
21	Spot film device, tomography
22	DSI, tomography
23	Wall stand
24	Tomography attachment
25	Select measuring chambers of automatic exposure control
26	
27	
28	Display
29	Slim patient
30	Stout patient
31	Scroll through the display pages

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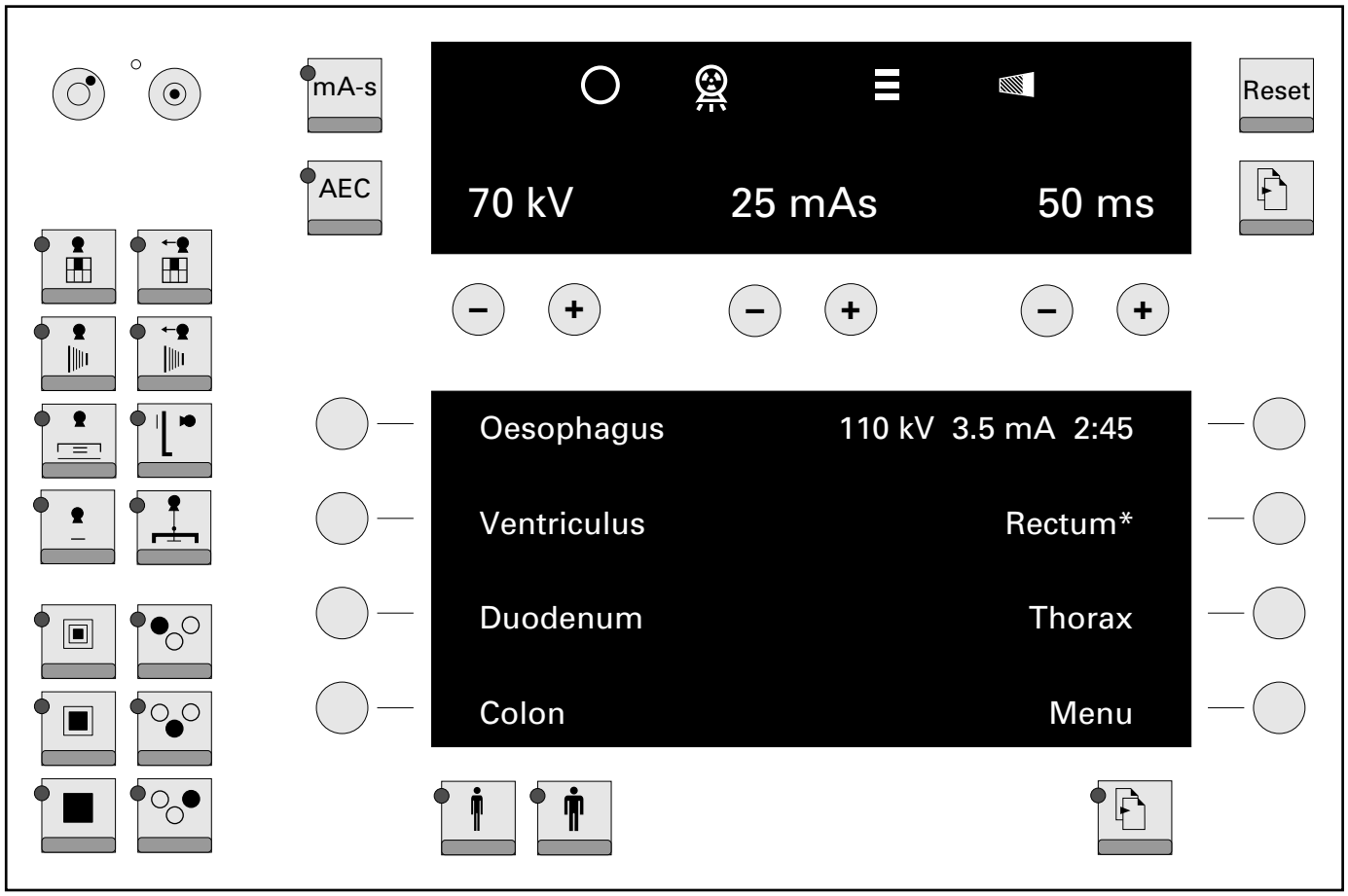
3.2.2 Keys and displays – detailed



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The upper display

Display and selection of the generator data.

Green Ready lamp: ready to make an exposure

Radiation is switched on

Display of tube assembly state
(depending on system and X-ray tube assembly, please also observe the instructions in the instructions for use for the X-ray tube assembly).

Colour(s)	Description
green	Full power available
yellow + gren	The tube assembly is warm, full power available
yellow	Up to 80 % of the full power is available
yellow + red	Up to 64 % of the full power is available
red	The thermo syfety switch in the tube assembly is activated: – radiographyy not possible – fluoroscopy current is limited to 3 mA

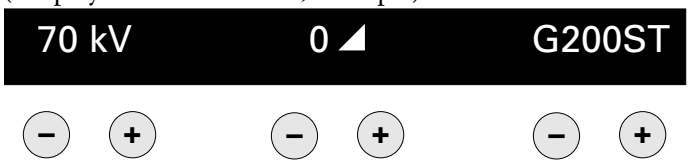
Incorrect exposure indicator; if it flashes
- you have let go of the exposure switch prematurely; press Reset

or
- the limit of exposure time or mAs has been reached; press Reset

or
- the exposure has been aborted owing to incorrect exposure (incorrect exposure early warning system), press Reset.

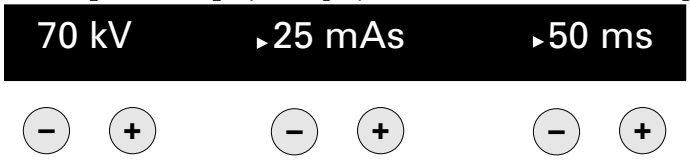
Display in the exposure data panel with AEC: kV, kV-mA and TDC techniques

(Display on the first level, example)



Display and selection of
- exposure voltage
- density correction at SFC only (at radiography with image intensifier only display)
- screen-film combination (SFC, not for radiography with image intensifier)

Post-exposure display (Display on the second level, example)



The values of post-exposure display are marked by a triangle.

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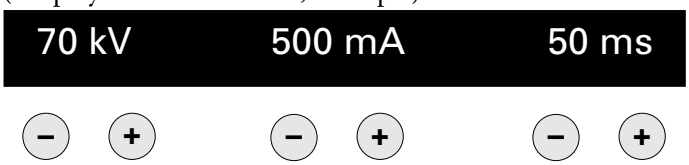
Display in the exposure data panel for the kV-mAs or kV-mAs-s technique:

(Display on the first level, example)

Display and selection of
- exposure voltage
- mAs product
- exposure time (selection only possible for kV-mAs-s technique)

Display in the exposure data panel for kV-mA-s technique

(Display on the first level, example)



Display and selection of
- exposure voltage
- exposure current
- exposure time

Change exposure data

- in steps: press − or + briefly
- continuously: press − or + longer

As an alternative to exposure data, error messages or instructions appear for the operator. For more information refer to the Appendix.

For information about the displays on levels 2, 3 and 4 refer to the Appendix (see chapter 7.2).

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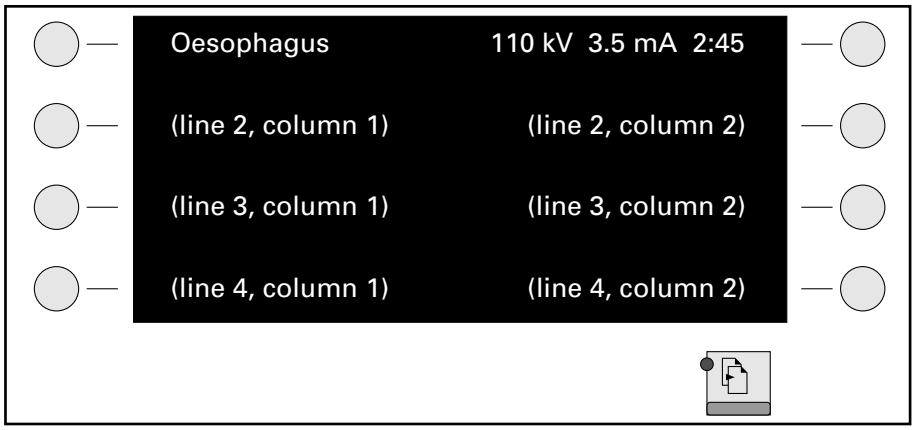
The lower display



Display and selection of the APR programs,
the current selection is highlighted.
If there is an APR menu, "Menu" appears on line 4, column 2. You can call it up with the button .

With you can scroll through the pages if the LED is lit and at least two pages have been programmed. After the last page, page 1 appears again.

If, after scrolling, you press the exposure switch on "Preparation" the following appear:
- the APR program last selected
- the appropriate exposure data.

If you have modified the data of a program, an asterisk appears after the name of the program. The modified data remain intact (even if you change the auxiliary for example) until you select the same program again or a different one.

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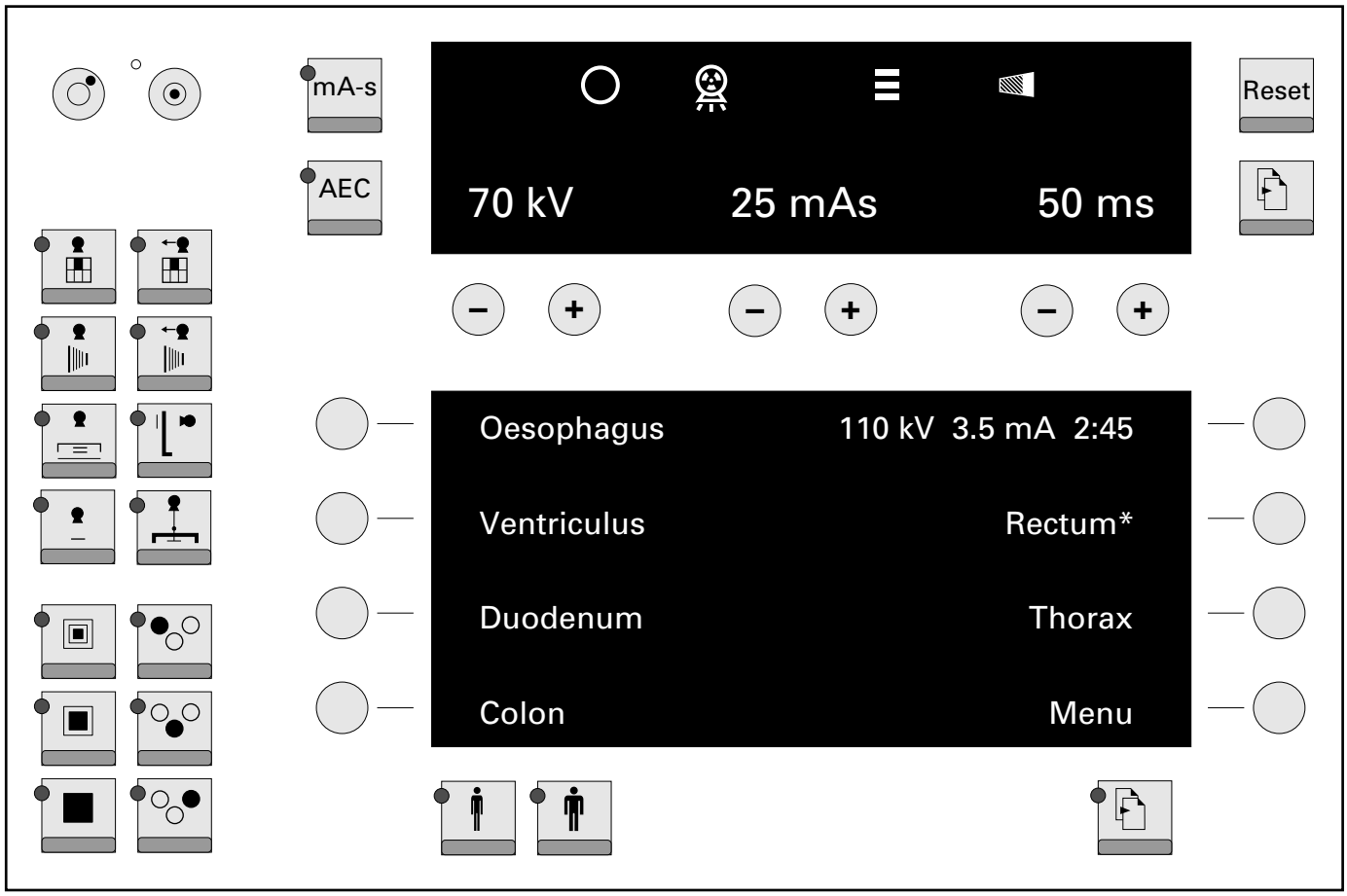
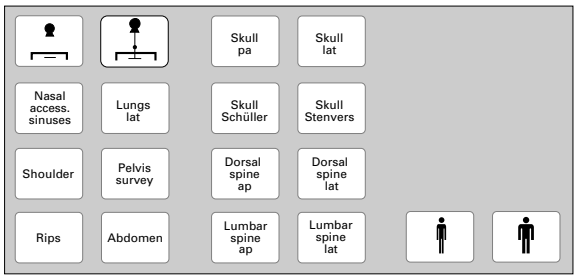


Optional keypad module (example)
(APR assignment, maximum configuration, depending on the system)



The 18 buttons on an optional keypad module are assigned as follows:

- 14 buttons for APR programs, each button can be assigned any auxiliary
- 2 buttons for selecting the auxiliairies
- 2 buttons for adjusting exposure data to the thickness of the patient's body

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The keys and their functions

.

Symbol	Description
	Switch off generator
	Switch on generator
	Toggle between kV-mA-s technique (LED is lit) and kV-mAs-s or kV-mAs technique (alternatively programmable)
	Switch on/off automatic exposure control
	– Switch off incorrect exposure indicator – Save modified APR data together with an APR button – Clear error message – New patient (PDO, option) – Switch off audible signal after 5 min of fluoroscopy
	Call up different levels
	Select focal spot:
	Small focal spot
	Variofocus (option)
	Large focal spot, standard at monofocal tubes
	Select measuring field(s) of the automatic exposure control (AEC). In the case of radiography with AEC on image intensifier (II) only the centre measuring field is illuminated. On systems with size sensing you can only select the outer measuring fields if the cassette is inserted.
	Adapt exposure data to the thickness of the patient's body:
	Slim patient
	Stout patient
	Select auxiliaries (examples):
	Spot-film device
	Spot-film device, tomography
	DSI
	DSI, tomography
	Angiography with Puck
	Wall stand
	Free cassette
	Tomography attachment
	Bucky

For further information about the button symbols refer to section 8.4.

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4 Operation

4.1 Operation of all configurations

4.1.1 Switching the generator on/off

Switch generaor on

The generator performs a self-test:
- All the lamps and display segments light up briefly.
- There is an audible signal.

During this test you should check the following:
- Do all the lamps and display segments light up?
- Is there an audible signal?

If a fault occurs, please call the Customer Service. If an error message appears, you will find help in the Appendix (see chapter 7.1).

After the self-test the generator assumes the state as it was before the equipment was last switched off.

Before you switch off the generator:

Wait for 1 min

after an exposure or after pressing the preparation button so that the rotating anode can decelerate.

In an emergency switch off immediately.

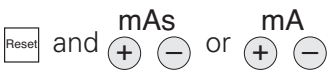
Switch generaor off

The generator and all connected auxiliaries will be switched off.

4.1.2 Setting display brightness

Press the buttons in the order indicated in the description below and keep them pressed for as long as you wish to change the brightness.

For settinig the display
- of exposure data panel,
- of the APR indicator not selected and
- possibly of the fluoroscopy indicator:



With ⊖ brightness is reduced and with ⊕ it increases.

For settinig the display
- of the APR program selected (highlighted):

With ⊖ brightness is reduced and with ⊕ it increases.

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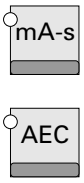
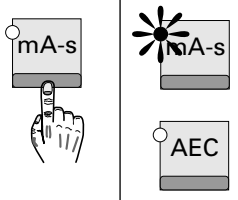
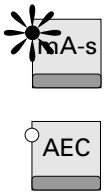
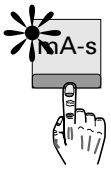
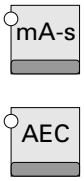
4.2 Operation of the basic configuration

4.2.1 Exposure techniques

The following exposure techniques are available:
- kV-mAs technique
- kV-mA-s technique

The table on the right shows how to switch between the individual techniques.

Initial state	Switch over to	
	kV-mAs	***kV-mA-s***
kV-mAs 		
kV-mA-s 	 	

4.2.2 Making X-ray exposures

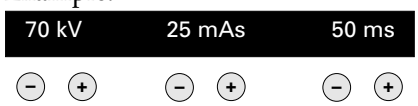
1 Select auxiliary
The LED is lit

2 Select focal spot

only with Variofocus (option)
The LED is lit

3 Enter exposure data

Example:



4 If necessary, adapt exposure data to the thickness of the patient's body
Depending on programming by Customer Service kV and mAs are adapted in dose-equivalent increments for each auxiliary.

5 Position patient

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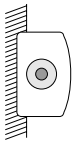

6 **Collimate!**

7 Release preparation (step 1)

goes out briefly

8 Release exposure (step 2)
Hold down button until you hear the audible signal. If you release before the signal sounds you abort the exposure. Do not press the button more than three times a minute; this increases the life of the X-ray tube.

You can also press the button straight through to step 2. After the preparation time the exposure is released.

is lit; preparation/exposure or fluoroscopy can also be indicated visually (optional).

After exposure
- There is an audible signal
- goes out
- The exposure data remain intact

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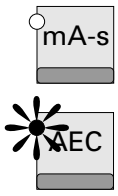
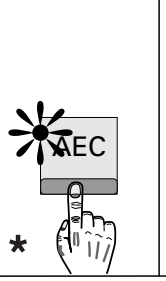
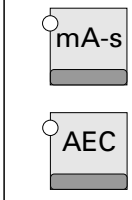
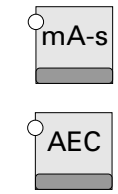
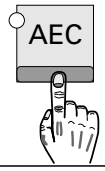
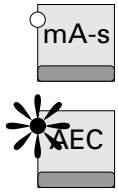
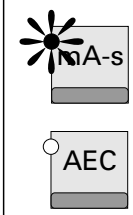
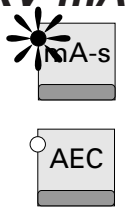
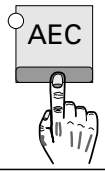
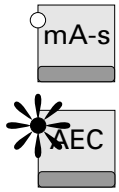
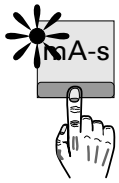
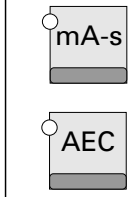
4.3 Operation with AEC, without APR

4.3.1 Exposure techniques

The following exposure techniques are available:
- kV technique
- kV-mAs technique
- kV-mA-s technique

The table below shows you how to switch between the individual techniques:

Initial state	Switch over to		
	kV	***kV-mAs***	***kV-mA-s***
kV 		 	
kV-mAs 	 		
kV-mA-s 	 	 	

* Display exposure parameters: press key again.

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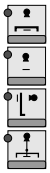
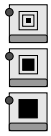
4.3.2 Making X-ray exposures

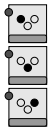


1 Select auxiliary
The LED is lit



2 Select focal spot

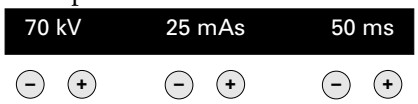
only with Variofocus (option)
The LED is lit



3 Select measuring field
- The LED lights up in the fields selected.
- If you switch OFF all the measuring fields, AEC goes out.

4 Enter exposure data

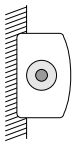
Example:



5 If necessary, adapt exposure data to the thickness of the patient's body
Depending on programming by Customer Service the following are adapted for each individual auxiliary:
- kV and mAs in dose-equivalent increments
- density in increments of 6%, 12%, 25%.

6 Position patient

7 **Collimate!**



8 Release preparation (step 1)

goes out briefly

9 Release exposure (step 2)
Hold down button until you hear the audible signal. If you release before the signal sounds you abort the exposure. Do not press the button more than three times a minute; this increases the life of the X-ray tube.

You can also press the button straight through to step 2. After the preparation time the exposure is released.

is lit; preparation/exposure or fluoroscopy can also be indicated visually (optional).

After exposure
- There is an audible signal
- goes out
- The exposure data remain intact
- Post-exposure display appears for 25 s
  To call up the post-exposure display again press .

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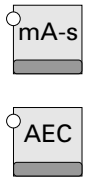
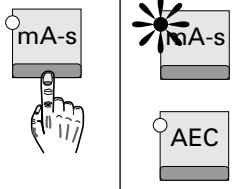
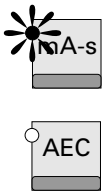
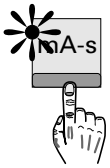
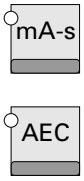
4.4 Operation with APR, without AEC

4.4.1 Exposure techniques

The following exposure techniques are available:
- kV-mAs technique
- kV-mAs-s technique
- kV-mA-s technique

The table on the right shows you how to switch between the individual techniques. During installation the kV-mAs technique and the kV-mAs-s technique can be programmed as alternatives.

<table>
<tr><th>Initial state</th><th colspan="3">Switch over to</th></tr>
<tr><th></th><th colspan="2">kV-mAs or kV-mAs-s*</th><th>kV-mA-s</th></tr>
<tr><td>kV-mAs or kV-mAs-s*
  </td><td colspan="2"></td><td>  </td></tr>
<tr><td>kV-mA-s
  </td><td>  </td><td>  </td><td></td></tr>
</table>

* Depending on APR programming by Customer Service

4.5 The APR records

4.5.1 Lists and groups

During installation the generator is equipped with APR records from a library.
- You can select a program from a **list** of APR programs

or
- you can select a program from a **group** of APR programs.
  Groups are APR programs collected according to regions of the body, which then appear on the display under the generic term, the name of the group.

In addition you can change the exposure data of the program selected.

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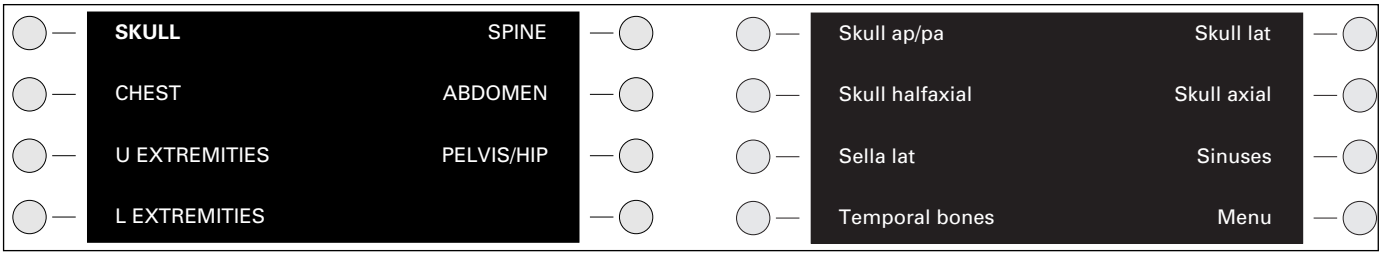
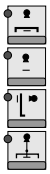
4.5.2 Selecting a program from a group of programs (if saved)

Example:



The left-hand illustration shows the regions of the body.

If, as highlighted, you select "Skull", the display of APR programmes appears, as shown in the right-hand illustration.



1 Select an auxiliary
- The LED lights up
- The last APR setting selected appears

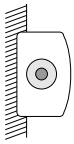
2 press key
The groups assigned to that auxiliary appear

3 Select group
- The names of the APR programs assigned appear.
- If there are more programs than can be displayed, lights up.
- With you can switch between pages.

4 Select APR program
The name of the program is **highlighted** and the appropriate exposure data appear.
If you do not select any APR program after selecting a group the name of the last program selected is **highlighted** after pressing the exposure switch; the appropriate exposure data remain valid.

5 Position patient

6 **Collimate!**



7 Release preparation (step 1)

goes out briefly

8 Release exposure (step 2)
Hold down button until you hear the audible signal. If you release before the signal sounds you abort the exposure. Do not press the button more than three times a minute; this increases the life of the X-ray tube.

You can also press the button straight through to step 2. After the preparation time the exposure is released.

is lit; preparation/exposure or fluoroscopy can also be indicated visually (optional).

After exposure
- There is an audible signal
- goes out
- The exposure data remain intact

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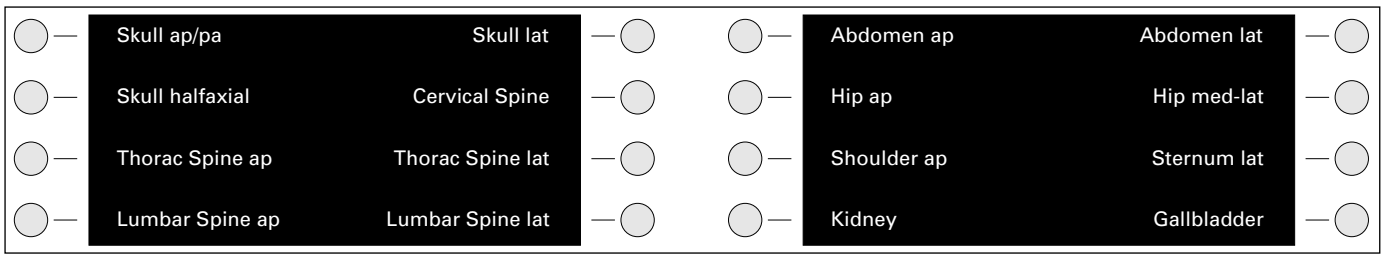
- Post-exposure display appears for 25 s

If you wish to call up the name of the group again: Press Menu — ◯ .

4.5.3 Selecting a program from a list of APR programs

Customer Service can enter APR programs according to your requirements. The local guidelines must be observed. If there are any departures, reasons must be given in writing. Other APR programs can be filed under the buttons of an assigned module.

Example:

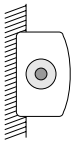


1 Select an auxiliary
- The LED lights up.
- The page with the last program called up and the name of the program is **highlighted**.
- If there are more programs than can be shown on the display, you can scroll through the pages with . After the last page the first page displayed reappears.

2 Select an APR program
The name of the program is **highlighted** and the corresponding exposure data appear.

3 Position patient

4 **Collimate!**



5 Release preparation (step 1)

goes out briefly

6 Release exposure (step 2)
Hold down button until you hear the audible signal. If you release before the signal sounds you abort the exposure. Do not press the button more than three times a minute; this increases the life of the X-ray tube.

You can also press the button straight through to step 2. After the preparation time the exposure is released.

is lit; preparation/exposure or fluoroscopy can also be indicated visually (optional).

After exposure
- There is an audible signal
- goes out
- The exposure data remain intact.

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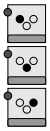
4.5.4 Overriding exposure data of an APR program

You can change:

Focal spot

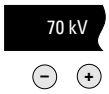
Select focal spot
only with Variofocus (option)
The LED is lit.

Measuring field



Select measuring field
- The LED is lit.
- If you switch OFF all the measuring fields, the automatic exposure control shuts down, i.e. AEC goes out.
  Switch AEC back on again and select measuring field.

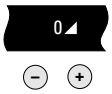
Exposure voltage



With ⊖ ⊕ change the exposure voltage.

Density correction

Only possible with AEC.



With ⊖ ⊕ change the density correction.

mAs value

With ⊖ ⊕ change the mAs value.

Exposure current

With ⊖ ⊕ change the exposure current.

Film/screen combination

Only possible with AEC.

With ⊖ ⊕ change the film/screen combination – max. 5 FSC per auxiliary (see chapter 7.3).

Exposure time

With ⊖ ⊕ change the exposure time.
Not possible with
- tomography auxiliaries with automatic tomographic time input,
- kV-mAs technique.

If you have changed the data of a programme, an asterisk appears after the name of the program (see chapter 3.1.7).

Example:

The overridden data remain intact – even if you change e.g. the auxiliary – until you select the same program again or a different one.

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4.5.5 Saving overridden data

Press Reset and the button ● of the required APR program in this sequence and hold them down for longer than 2 s.

If required Customer Service can prevent the possibility of saving data which have been changed.

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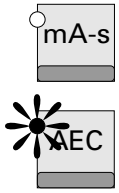
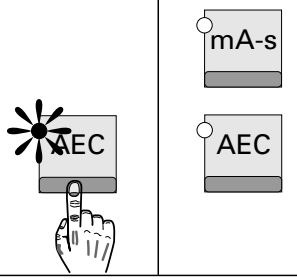
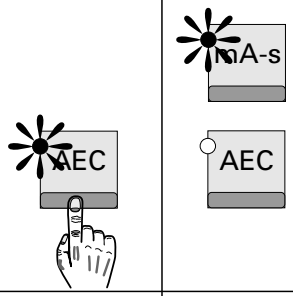
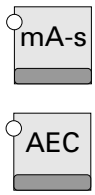
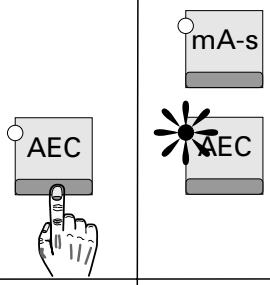
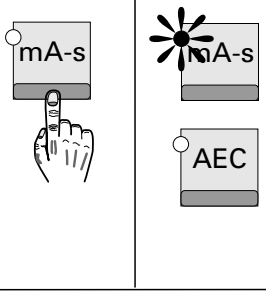
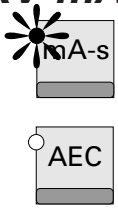
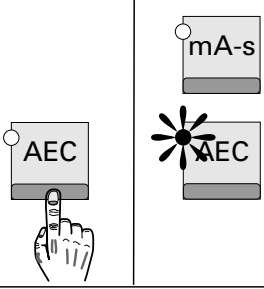
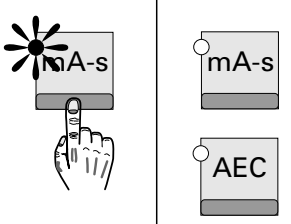
4.6 Operation with AEC and APR

4.6.1 Exposure techniques

The following exposure techniques are available:
- kV technique
- kV-mA technique
- kV-mAs technique
- kV-mAs-s technique
- kV-mA-s technique

The table below shows you how to switch between the individual techniques:

Initial state	Switch over to		
	kV *or* ***kV-mA***	***kV-mAs*** *or* ***kV-mAs-s****	***kV-mA-s***
kV *or* ***kV-mA*** 			
kV-mAs *or* ***kV-mAs-s**** 			
kV-mA-s 			

* During installation the kV-mAs and kV-mAs-s techniques can be programmed as alternatives.

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4.6.2 Lists and groups

During installation the generator is equipped with APR records from a library.

- You can select a program from a **list** of APR programs

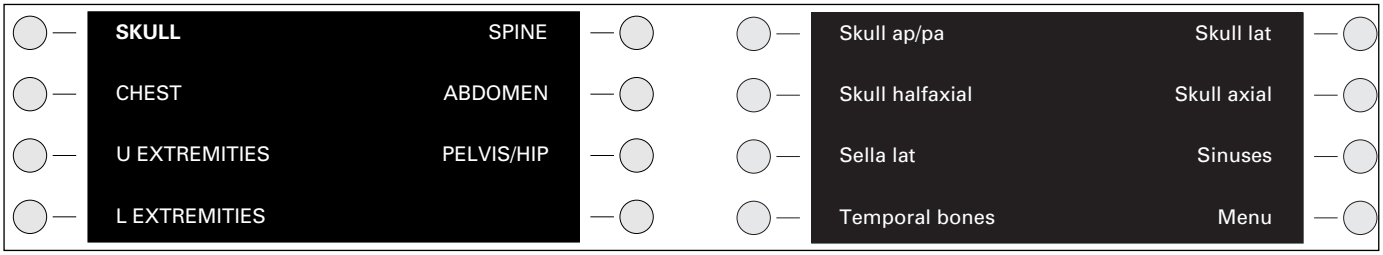
or

- you can select a program from a **group** of APR programs.
  Groups are APR programs collected according to regions of the body, which then appear on the display under the generic term, the name of the group.

In addition you can change the exposure data of the program selected.

4.6.3 Selecting a programme from a group of programs (if saved)

Example:



The left-hand illustration shows the regions of the body.

If, as highlighted, you select "Skull", the display of APR programmes appears, as shown in the right-hand illustration.

1 Select an auxiliary
- The LED lights up
- The last APR setting selected appears

2 press key
The groups assigned to that auxiliary appear

3 Select group
- The names of the APR programs assigned appear.
- If there are more programs than can be displayed, lights up.
- With you can switch between pages.

4 Select APR program
The name of the program is **highlighted** and the appropriate exposure data appear.
If you do not select any APR program after selecting a group the name of the last program selected is **highlighted** after pressing the exposure switch; the appropriate exposure data remain valid.

5 If necessary, adapt exposure data to the thickness of the patient's body
Depending on programming by Customer Service the following are adapted for each individual auxiliary:
- kV and mAs in dose-equivalent increments
- density in increments of 6 %, 12 %, 25 %

6 Position patient

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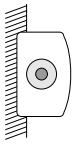
7 **Collimate!**



8 Release preparation (step 1)

goes out briefly

9 Release exposure (step 2)
Hold down button until you hear the audible signal. If you release before the signal sounds you abort the exposure. Do not press the button more than three times a minute; this increases the life of the X-ray tube.

You can also press the button straight through to step 2. After the preparation time the exposure is released.

is lit; preparation/exposure or fluoroscopy can also be indicated visually (optional).

After exposure
- There is an audible signal
- goes out
- In the case of exposures without automatic exposure control the exposure data remain intact.
- In the case of exposures with automatic exposure control the post-exposure display remains for 25 s.
  If you wish to call up the post-exposure display again: press .

If you wish to call up the name of the group again: Press Menu

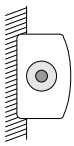
You can repeat the exposure using the same exposure data but without automatic exposure control:

1 Switch off AEC
If after 25 s the post-exposure display disappears to level 2, you must first call up the post-exposure display of the last exposure and then switch AEC off.

2 Call up post-exposure display of the last exposure

3 Position patient if necessary

4 **Collimate** if necessary!

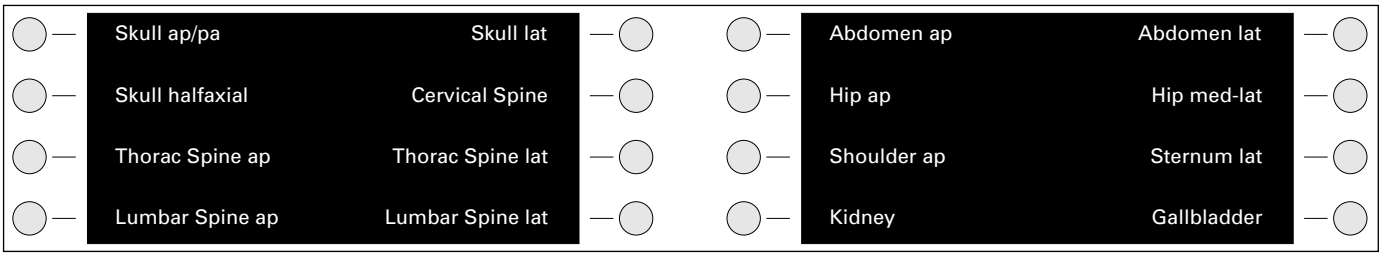


5 Release preparation and exposure (see above)

4.6.4 Selecting a program from a list of APR programs

Customer Service can enter APR programs according to your requirements. The local guidelines must be observed. If there are any departures, reasons must be given in writing. Other APR programs can be filed under the buttons of an assigned module.

Example:



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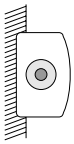
1 Select an auxiliary
- The LED lights up.
- The page with the last program called up and the name of the program is **highlighted**.
- If there are more programs than can be shown on the display, you can scroll through the pages with . After the last page the first page displayed reappears.

2 Select an APR program
The name of the program is **highlighted** and the corresponding exposure data appear.

3 Position patient

4 **Collimate!**



5 Release preparation (step 1)

goes out briefly

6 Release exposure (step 2)
Hold down button until you hear the audible signal. If you release before the signal sounds you abort the exposure. Do not press the button more than three times a minute; this increases the life of the X-ray tube.

You can also press the button straight through to step 2. After the preparation time the exposure is released.

is lit; preparation/exposure or fluoroscopy can also be indicated visually (optional).

After exposure
- There is an audible signal
- goes out
- In the case of exposures without automatic exposure control the exposure data remain intact.
- In the case of exposures with automatic exposure control the post-exposure display remains for 25 s.
  If you wish to call up the post-exposure display again: press .

You can repeat the exposure using the same exposure data but without automatic exposure control:

1 Switch off AEC
The exposure data last used appear.

4.6.5 Selecting exposure current for kV-mA technique

With the kV-mA technique you can select the exposure current for the next exposure. You can also program it as default according to your applicational requirements, e.g. to extend the exposure time for making an exposure of the odontoid process of the axis.

For the kV-mA technique you set the exposure current
- in the **kV-mA-s technique** direct or
- indirectly in the **kV-mAs-s technique**.

Please adhere to the sequence of steps.

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a. Setting via the kV-mA-s technique

1 Switch off AEC
The generator switches to the kV-mA-s technique; if the generator is programmed to the kV-mAs-s technique, continue at b.

2 Set exposure current
If, for example, you reduce exposure current, the exposure time is correspondingly longer in the kV-mA technique.

3 Switch on AEC
As a result the exposure current last set is defined **for the next exposure**; automatic exposure control regulates exposure time accordingly.

If required you can save these data (see chapter 4.5.5).

If you wish to save the overwritten data, you must select the exposure time before saving so that the mAs product assumes an anatomical value.

4 Set exposure time

b. Setting via the kV-mAs-s technique

1 Switch off AEC
The generator switches to the kV-mAs-s technique.

2 Set anatomical mAs
Exposure current is set automatically via mAs.[1)]

3 Set anatomical exposure time

4 Switch on AEC
As a result exposure current is indirectly defined **for the next exposure**; automatic exposure control regulates exposure time accordingly.

If required you can save these data (see chapter 4.5.5).

1) If you wish to change the exposure current directly:

Switch on mA-s
The generator switches to the kV-mA-s technique.

Proceed as described in a), step 2.

4.7 Tomography

4.7.1 Making tomographic exposures without automatic exposure control (TDC)

1 Select tomography
If units are equipped with a remote selection feature, the generator switches over automatically to tomography if you select this mode at the unit.

- The LED lights up.
- kV-mA-s or kV-mAs-s technique is activated.

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- If there are more programmes than can be shown on the display, you can scroll through the pages with . After the last page the first page displayed reappears.

2 Select APR program
The name of the programme is **highlighted**.

3 Prepare auxiliary for tomography (see Operator's Manual for the auxiliary).

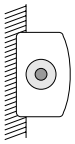
4 On the auxiliary select a tomo trajectory which matches the APR program selected (see Operator's Manual for the auxiliary).

5 Set exposure time
Exposure time and tomographic time must agree.
If necessary, match exposure time to tomographic time.

6 Select mAs or mA (depending on the programming)
- After selecting a tomo trajectory the respective exposure time will be automatically set on the generator if
  - the generator is equipped with "Automatic Tomographic Time Input" (optional) and
  - a suitable tomography unit is connected up.
- lights up.

7 Position patient

8 **Collimate!**



9 Release preparation (step 1)

goes out briefly

10 Release exposure (step 2)
Hold down button until you hear the audible signal. If you release before the signal sounds you abort the exposure. Do not press the button more than three times a minute; this increases the life of the X-ray tube.

You can also press the button straight through to step 2. After the preparation time the exposure is released.

is lit; preparation/exposure or fluoroscopy can also be indicated visually (optional).

After exposure
- There is an audible signal
- goes out

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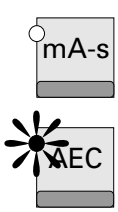
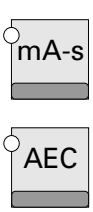
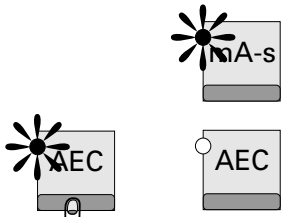
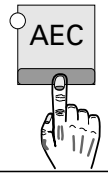
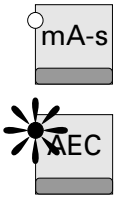
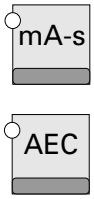
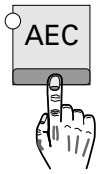
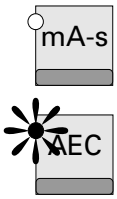
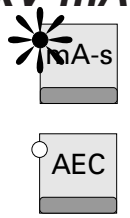
4.7.2 Tomographic exposures with automatic exposure control (TDC)

Via the option ”Automatic tomographic time input“ the unit transmits the specified exposure time to the generator. You cannot override it.
If you have selected tomography, the following table shows you how to switch between the individual techniques:

Initial state	Switch over to		
	TDC	***kV-mAs-s***	***kV-mA-s***
TDC		 	
kV-mAs-s	 		
kV-mA-s	 		

4.7.3 Making tomographic exposures with automatic exposure control (TDC)

1 Select tomography
If units are equipped with a remote selection feature, the generator switches over automatically to tomography if you select this mode at the unit.

- The LED lights up.
- kV-mA-s or kV-mAs-s technique is activated..

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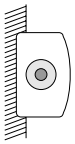
- If there are more programmes than can be shown on the display, you can scroll through the pages with . After the last page the first page displayed reappears.

2 Select APR program
The name of the programme is **highlighted**.
Prepare auxiliary for tomography (see Operator's Manual for the auxiliary).

3 If necessary, adapt exposure data to the thickness of the patient's body
Depending on programming by Customer Service the following are adapted for each individual auxiliary:
- kV and mAs in dose-equivalent increments
- density in increments of 6 %, 12 %, 25 %.

4 Position patient

5 **Collimate!**



6 Release preparation (step 1)

goes out briefly

7 Release exposure (step 2)
Hold down button until you hear the audible signal. If you release before the signal sounds you abort the exposure. Do not press the button more than three times a minute; this increases the life of the X-ray tube.

You can also press the button straight through to step 2. After the preparation time the exposure is released.

is lit; preparation/exposure or fluoroscopy can also be indicated visually (optional).

After exposure
- There is an audible signal
- goes out

If there has been an incorrect exposure, see next chapter.

4.7.4 Selecting initial current for TDC

If there has been an incorrect exposure, you must correct the initial current. This can also be performed for existing programmes if the application requires.

You can set the initial current for TDC
- in the **kV-mA-s technique** direct or
- indirectly in the **kV-mAs-s technique**.

Please adhere to the sequence of steps.

a. Setting via the kV-mA-s technique

1 Switch off AEC
The generator switches to the kV-mA-s technique; if the generator is programmed to the kV-mAs-s technique, continue at b.

2 Set initial current

3 Switch on AEC
As a result the initial current last set is defined **for the next exposure**

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If required you can save these data (see chapter 4.5.5).

4 Set exposure time

b. Setting via the kV-mAs-s technique

1 Switch off AEC
The generator switches to the kV-mAs-s technique.

2 Set anatomical mAs
The initial current is set automatically via mAs.[1)]

3 Switch on AEC
As a result the initial current is indirectly defined **for the next exposure**.

If required you can save these data (see chapter 4.5.5).

1) If you wish to change the initial current directly:;

Switch on mA-s
The generator switches to the kV-mA-s technique

Proceed as described in a., step 2.

4.8 Fluoroscopy

4.8.1 Performing fluoroscopy

1 Select fluoroscopy unit
- The LED lights up.
- The names of the APRF programs (if APR option is installed) or of the groups which have been assigned to the fluoroscopy unit appear.
- Line 1, column 2 is reserved for fluoroscopy data and is not available for APRF programmes or groups.
- The name of the APRF program last called up under this auxiliary (if APR option is installed) or of the group last selected is **highlighted**.

2 Select APRF program
The name of the programme is **highlighted**.

3 Release fluoroscopy on the fluoroscopy unit (footswitch, release switch).
You cannot release fluoroscopy on the generator.

During fluoroscopy
- lights up,
- kV and mA are controlled automatically according to the programmed fluoroscopy characteristic,
- the following appear on line 1, column 2
  - fluoroscopy voltage,
  - fluoroscopy current and
  - fluoroscopy time in min:s

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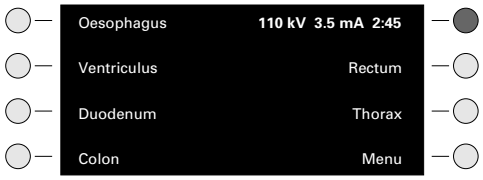
Example:

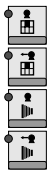


- there is a continuous tone after 5 min; if you fail to switch it off with within another 5 min, fluoroscopy will be shut down. Then no further action is possible until you press Reset or . Please bear in mind that Reset has more than one function (see chapter 3.2.2).
- if lights up in red, the max. fluoroscopy current will be limited to 3 mA.

If you cannot release fluoroscopy
- you have selected the wrong auxiliary
- an exposure is being made
- the door to the examination room is not closed or
- you have not switched off the audible signal.

After fluoroscopy
- goes out
- the total fluoroscopy time appears in min:s in line 1, column 2; you can delete it with Reset or . Please bear in mind that Reset has more than one function (see chapter 3.2.2).

4.8.2 Exposures with image intensifier or spot-film device (SCOPOMAT)

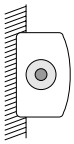


1 Select auxiliary
- The LED lights up.
- The names of the APRF programs or groups assigned to this auxiliary appear.
- The name of the APRF programme last called up under this auxiliary or of the group last selected is **highlighted**.

2 Select APRF program
- at the generator or
- at the auxiliary.

- The exposure data appear at the generator control desk.
- The name of the program is **highlighted**.

3 If necessary select other parameters (e.g. frame rate);
for more details refer to the Operator's Manual for the auxiliary.



4 Release preparation (step 1)
goes out briefly

5 Release exposure (step 2)
If you wish to make a series of exposures you must keep the release switch pressed until the end of the series.

lights up for each exposure; preparation/exposure or fluoroscopy can also be indicated visually (optional).

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After exposure
- There is an audible signal
- goes out
- In the case of exposures without automatic exposure control the exposure data remain intact.
- In the case of exposures with automatic exposure control the post-exposure display remains for 25 s.
  If you wish to call up the post-exposure display again: press .

4.8.3 Special exposures for therapy simulation

These are only possible if the auxiliary is appropriately equipped.

1 Select auxiliary for therapy simulation
- Normal fluoroscopy takes place on a different auxiliary.
- The LED lights up.
- The names of the APRF programs or groups assigned to this unit appear.
- Line 1, column 2 is reserved for exposure data and is not available for APRF programmes of groups.
- The name of the APRF programme last called up under this auxiliary or of the group last selected is **highlighted**.

2 Select APRF program
- The name of the programme is **highlighted**.
- kV, mA and max. exposure time are preset by the APRF program.

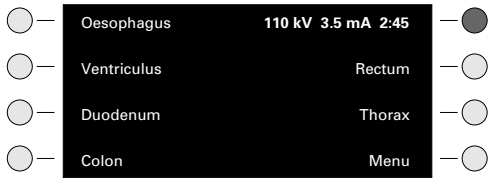
If lights up green or green and yellow:

3 set fluoroscopy time to ”0“ with Reset or .
If lights up yellow, yellow and red or red, no exposures are possible.
Allow the tube assembly to cool down.

4 Release exposure
at the system release switch for special exposure technique.

During exposure
- lights up ,
- the following appear in line 1, column 2:
  - exposure voltage,
  - exposure current and
  - exposure time + any accumulated fluoroscopy time.

Example:



- there is an audible signal after 5 min; if you fail to switch it off within another 5 min with Reset or , exposure is shut down or interrupted. Then no further action is possible until you press Reset or . Please bear in mind that Reset has more than one function (see chapter 3.2.2).

If you cannot release an exposure
- you have selected the wrong auxiliary
- the door to the examination room is not closed
- you have not switched off the audible signal or

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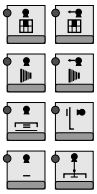
- lights up yellow, yellow + red or red. Allow the tube assembly to cool down.

After exposure
- there is an audible signal
- goes out.

4.9 Dose display

(optional, depends on system)
This appears only if an auxiliary with size sensing has been selected. The computer totalises and stores the area dose products of all the exposures. If you switch examination rooms with the auxiliary, this total remains intact and is again available when you select the examination room again. The values are lost if you press or .



1 Select auxiliary
The LED lights up.

2 Call up level 3
The total of area dose products [cGycm^2] of all exposures for the current patient in the room selected appears.

3 Delete dose display per tube
The dose display is also deleted, if
- the PDO (optional, see separate Operator's Manual) reports: "End of Examination"
- the DigitalDiagnost system reports: "End of Examination".

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5 Maintenance

As with any technical appliance this X-ray equipment also requires
- proper operation,
- regular testing by the user,
- regular service and repair.

By taking these precautions you maintain the operability and operational reliability of the system. As the user of an X-ray unit you are obliged according to accident prevention regulations, the medical products law and other regulations to take such precautions.

Maintenance consists of **tests which the user can perform** and **maintenance** which is performed under service agreements, Philips service orders or by persons explicitly authorised to do so by Philips.

5.1 Tests by the user

The user must check the X-ray equipment for apparent defects (see table). If operational defects or other departures from normal operational behaviour occur, he must switch off the X-ray unit and inform the Service Organisation. He may only resume operation of the X-ray equipment when it has been repaired. Operation using faulty components may lead to an increased safety risk or unnecessarily high exposure to radiation.

Interval	Scope	Method
Daily	Stability test	
Daily	Faulty display lamps, damaged components, labels and warning signs	Inspection
Weekly	All cables and terminals (damage, breakage)	Inspection
Weekly	Oil leaks and unusual noises	Inspection
Weekly	Check for AEC function	See chapter 5.2
6 months	Check operation of dose rate control	See chapter 5.2

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5.2 Checking performance of dose rate control / AEC function according IEC 60601-2-7

5.2.1 Dose rate control

You must check performance of the dose rate control at least once a month. To do so, proceed as follows:

- Select APRF programme* (no lock-in)
- Open the diaphragm (maximum I.I. format)
- Switch on automatic kV control
- Switch on fluoroscopy
- Fluoroscopy display must be <60 kV
- Completely close diaphragm
- Fluoroscopy display must be >100 kV after approx. 2.5 s.

* The kV-mA characteristics must be programmed by Customer Service so that the limits described can be reached.

5.2.2 AEC function

- Select AEC fixed current
- Set values: 40 kV, 25 mA, small focus
- SID: 100 cm
- Collimator prefilter: no
- Release an exposure and write down the exposure time
- Collimator prefilter: max. Cu + Al
- Release an exposure and write down the exposure time
- The exposure time for the 2nd exposure must be at least twice as long.

5.3 Safety checks according to the Medical Device Directive

The safety checks cover operability and operational reliability. They must be performed at least every 2 years. These tests constitute part of our preventive maintenance under our service agreements. They cover

- visual checking for completeness and apparent damage or defects as well as soiling, sticking parts and wear and tear which may affect safety,
- testing the necessary monitoring, safety, display and indicating systems,
- measuring the safety-relevant output parameters,
- checking electrical safety as well as the operability of an internal energy supply,
- for the particular product other special technical tests according to the generally accepted standards of engineering practice,
- other necessary tests specified by the manufacturer,
- recording results and filing the test reports in the X-ray system manual (medical products logbook).

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5.4 Maintenance

X-ray units contain mechanical components such as drive chains, ropes, steel strips and gears which are subjected to wear and tear due to operation. They include means of suspension for heavy components (e.g. image intensifier, X-ray tube assembly etc.). After a lengthy period of operation the safety of the suspension may be impaired by wear and tear (e.g. rope break).

The correct setting of the electromechanical and electronic assemblies affects the functioning, image quality, electrical safety and exposure of the patient and medical personnel to radiation.

Philips recommends you to
- **perform the tests indicated in the table on a regular basis,**
- **have the X-ray unit serviced by the Philips Service Organisation at least once a year. You must have heavily used X-ray equipment subjected to maintenance more frequently.**

In this way you avoid endangering the patient and you meet your obligations.

By entering into a service agreement with Philips you retain the value and safety of your X-ray equipment. All the necessary maintenance, including the safety tests for the purpose of preventive avoidance of danger and the necessary settings for optimum image quality and minimum exposure to radiation, are performed at regular intervals. Philips agrees on these intervals with you, taking the legal requirements into account.

Faulty components which affect the safety of the X-ray equipment must be replaced by genuine spare parts.

5.5 Recording results

Service and repairs must be entered in the medical products logbook, including the following data:
- type and scope of work,
- if necessary, details of any changes to ratings or the working zone,
- date, person performing the work, signature.

5.6 Cleaning

Please bear the following in mind when choosing a detergent:
To clean plastic surfaces you must never use anything other than soap and water. If other detergents are used (e.g. with a high alcohol content) the material will become matt or tend to crack. Never use any corrosive, solvent or abrasive detergents or polishes.

When cleaning, please observe the following:
- Before cleaning the X-ray equipment switch off at the mains. The capacitor may still be live 4 hours after switching off.

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- Ensure that no water or other liquids can enter the X-ray equipment. This precaution prevents electrical short-circuits and corrosion forming on components.
- You should wipe enameled parts and aluminium surfaces only with a damp cloth and mild detergent and then rub with a dry woollen cloth.
- Rub down chrome parts with a dry woollen cloth only.

5.7 Disinfection

The method of disinfection used must conform to the legal regulations and guidelines regarding disinfection and explosion protection.

Never use any corrosive, solvent or abrasive detergents or polishes.

If you use disinfectants which form explosive mixtures of gases, these must first have evaporated before you switch the X-ray equipment on again.

- Before disinfecting the X-ray equipment switch off at the mains.
- You may disinfect all parts of the X-ray equipment, including the accessories and connecting cables, by wiping only.
- Disinfection by spraying is not to be recommended because the disinfectant may enter the X-ray equipment.
- If you perform a room disinfection with an atomizer, you must switch off the X-ray equipment first. When the X-ray equipment has cooled down, cover it over carefully with a plastic sheet. When the mist of disinfectant has subsided you can remove the plastic sheets and disinfect the X-ray equipment by wiping.

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6 Technical data

6.1 Electrical data

		Optimus 50	Optimus 65	Optimus 80
Safety class		1	1	1
EMC emission (IEC 60601-1-2/CISPR 11)			Group 1, class A	
Power supply			400 V ±10%, 50 Hz and 60 Hz, 3 phase	
Main resistance/ Main resistance		≤0.3 Ω/145 A	≤0.2 Ω/190 A	≤0.2 Ω/230 A
Max. current input is reached under the following conditions:	Tube power	50 kW	65 kW	80 kW
	Technique	kV-mAs	kV-mAs	kV-mAs
	Focal spot	large	large	large
	High voltage	77 kV	81 kV	80 kV
	mAs product	65 mAs	80 mAs	100 mAs
	Exposure time	0.1 s	0.1 s	0.1 s
Electrical output (IEC 60601-2-7)		50 kW	65 kW	80 kW
High voltage generation			Converter	
Ripple			DC voltage	
Radiography	Max. voltage	150 kV	150 kV	150 kV
	Nom. electric power (100 kV; 0.1 s)	50 kW	65 kW	80 kW
	Max. electric power	50 kW	65 kW	80 kW
		650 mA/70 kV/0.1 s	900 mA/70 kV/0.1 s	1100 mA/70 kV/0.1 s
		625 mA/80 kV/0.1 s	812 mA/80 kV/0.1 s	1000 mA/80 kV/0.1 s
		500 mA/100 kV/0.1 s	600 mA/100 kV/0.1 s	800 mA/100 kV/0.1 s
		400 mA/125 kV/0.1 s	520 mA/125 kV/0.1 s	640 mA/125 kV/0.1 s
		333 mA/150 kV/0.1 s	433 mA/150 kV/0.1 s	533 mA/150 kV/0.1 s
Fluoroscopy	Max. voltage		110 kV/6 mA (125 kV)* * programmable by Customer Service	
Continuous output (for a practical set-up consisting of fluoroscopy and radiography) Classification according to Medical Device Directive 93/42/EEC-IIb.		500 W (6 f/min bei 50 kW; 0.1 s	500 W (6 f/min bei 65 kW; 0.1 s	500 W (6 f/min bei 80 kW; 0.1 s

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Exposure techniques

- kV, continuously falling load, automatic exposure control (one-factor technique)
- kV, mA, constant current operation, automatic exposure control (two-factor technique)
- TDC, automatic exposure control with tomography (dose-rate controlled tomography)
- kV, mAs, constant load (two-factor technique)
- kV, mAs, s, constant load (three-factor technique)
- kV, mA, s, constant load (three-factor technique)

6.2 Setting ranges

		Optimus 50	Optimus 65	Optimus 80
Radiography without automatic exposure control (AEC)	Tube voltage	40 kV … 150 kV, adjustable in steps of 1 kV or according to a sequence the steps of which roughly correspond to an exposure increment[1]. In the case of tubes with lower maximum tube voltage this is limited accordingly.		
	Tube current	For kV-mA-s and kV-mAs techniques this can be adjusted in steps of 25%[1], 12% or 6% 1 mA … 650 mA	For kV-mA-s and kV-mAs techniques this can be adjusted in steps of 25%[1], 12% or 6% 1 mA … 900 mA	For kV-mA-s and kV-mAs techniques this can be adjusted in steps of 25%[1], 12% or 6% 1 mA … 1100 mA
	mAs	0.5 mAs … 850 mAs, adjustable in steps of 25%[1], 12% or 6% Compliance range as per IEC 60601-2-7: 2,0 mAs … 850 mAs		
	Exposure times	1 ms … 6 s (16 s) adjustable in steps of 25%[1], 12% or 6%		
Radiography with AEC	mAs[2]	0.5 mAs … 600 mAs		
	Switching times	1 ms … 4 s		
	Density correction	Adjustable in steps of 25%, 12%[1] or 6%		
Tomography	mAs	0.5 mAs … 850 mAs in steps of 25%, 12% or 6%		
	Switching times	1 ms … 6 s (16 s) in steps of 25%, 12% or 6%		
Tomography with automatic exposure control (TDC)	mAs	0.5 mAs … 600 mAs in steps of 25%, 12% or 6%		
	Switching times	1 ms … 6 s		
Fluoroscopy	Tube voltage	40 kV … 125 kV, via kV/mA characteristics		
	Tube current	0,1 mA … 6 mA, via kV/mA characteristics		
Radiography for therapy simulation	Tube voltage	40 kV … 141 kV		
	Tube current	0.2 mA … 20 mA		
	Time	65 s		

[1] Default values:
±25% mAs corresponds to ±1 exposure density step.
±12% density correction corresponds to ±0.5 exposure density steps.

[2] The maximum mAs value can be set lower by the Customer Service.

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6.3 Ambient conditions for operation

Temperature	10 °C … 40 °C
Rel. humidity	15% … 90%, no condensation
Atmospheric pressure	70 kPa … 110 kPa

6.4 Accuracy of the operating data, tolerances

6.4.1 Compliance

with the requirements of IEC 60601-2-7 applying the IEC test conditions.

Current-time reference product

Reference value for the compliance range of linearity of the emitted radiation.
This table applies to tubes with X-ray generator nominal power and an exposure time of 100 ms at 100 kV. For tubes with a lower focal spot power the current-time reference product has to be converted accordingly.

	Current-time reference product		
	50 kW	65 kW	80 kW
70 kV, 320 mA	32 mAs		
70 kV, 400 mA		40 mAs	
70 kV, 500 mA			50 mAs
100 kV, 250 mA	25 mAs		
100 kV, 320 mA		32 mAs	
100 kV, 400 mA			40 mAs
150 kV, 160 mA	16 mAs		
150 kV, 200 mA		20 mAs	
150 kV, 250 mA			25 mAs

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Requirement	Compliance
Radiography	
Reproducibility of emitted radiation	complies
Linearity of limited radiation a) in relation to current-time product b) assuming consecutive settings or settings with a factor of ≤2	 n the range of > 2 mAs over the entire range of settings
Consistency of emitted radiation during automatic exposure control	complies
Accuracy of the X-ray tube load factors – Tube voltage – Tube current – Tube load time – Current-time product – Current-time reference product	complies

6.4.2 Tolerances of the indicated X-ray tube load factors

Radiography (Typical range of application)	
Tube voltage	±5%, additional ±1 kV
Tube current-time product	±3%, additional ±0.5 mAs
Tube current	±5%, additional ±0.5 mA
mAs post-exposure display in kV technique	±3%, additional ±0.5 mAs
Post-exposure time display	±3%, additional ±0.5 ms
Exposure time • Optimus 50 for I<10 mA • Optimus 65/80 for I<10 mA for I≤2 mA	 ±5%, additional ±0.5 ms ±5%, additional ±25 ms ±5%, additional ±0.5 ms ±5%, additional ±25 ms ±5%, additional +25 ms/-85 ms
Fluoroscopy (Typical range of application)	
Tube voltage	±5%, additional ±1 kV
Tube current	±5%, additional ±0.1 mA

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6.5 Compatibility

You can operate any OPTIMUS with RO and SRO tubes from Philips. Mixed operation is possible.

Philips recommends the following standard tubes:
RO 1648
RO 1750
SRO 0951
SRO 2550
SRO 33100

For other tubes which can be connected up consult the Customer Service.

You can connect the Patient Data Organiser (PDO) up to any Optimus. For more information please contact your Philips representative.

6.6 Methods of measurement

X-ray tube voltage
Tube voltage is measured with the aid of balanced high-voltage bleeders in the high-voltage circuit.

X-ray tube current
Tube current is measured on the cathode side in the rectified high-voltage circuit of the X-ray generator (100 ms section).

Load time
Load time is measured between 75% ±7.5% peak voltage of the high-voltage rise edge and 75% ±7.5% peak voltage of the high-voltage fall edge.

Current-time product
Current-time product is measured on the cathode side in the rectified high-voltage circuit of the X-ray generator.

6.7 EMC data

6.7.1 Electromacnetic immunity – recommended separation distances

(between portable and mobile RF communications equipment and this system)
This system is intended for use in an electromagnetic environment in which radiated RF disturbances are controlled. The customer or the user of this system can help prevent electromagnetic interference by maintaining a

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minimum distance between portable and mobile RF communications equipment (transmitters) and this system as recommended below, according to the maximum output power of the communications equipment.

Rated maximum output power of transmitter [W]	Separation distance according to frequency of transmitter [m]		
	150 kHz to 80 MHz $d = (3.5/3)P^{1/2}$	80 MHz to 800 MHz $d = (3.5/3)P^{1/2}$	800 MHz to 2.5 GHz $d = (7/3)P^{1/2}$
0.01	0.12	**0.12**	**0.23**
0.1	0.37	**0.37**	**0.74**
1	1.17	**1.17**	**2.33**
10	3.67	**3.67**	**7.38**
100	11.66	**11.66**	**23.33**

For transmitters rated at a maximum output power not listed above, the recommended separation distance d in metres [m] can be estimated using the equation applicable to the frequency of the transmitter, where P is the maximum output power rating of the transmitter in watts [W] according to the transmitter manufacturer.

- ***At 80 MHz and 800 MHz, the separation distance for the higher frequency range applies.***
- ***These guidelines may not apply in all situations. Electromagnetic propagation is affected by absorption and reflection from structures, objects and people.***

Guidance and manufacturer's declaration – electromagnetic emissions

This system is intended for use in the electromagnetic environment specified below. The customer or the user of this system should assure that it is used in such an environment.

Emissions test	Compliance	Electromagnetic environment – guidance
RF emissions CISPR 11	Group 1	This system uses RF energy only for its internal functions. Therefore, its RF emissions are low and are not likely to cause any interference in nearby electronic equipment.
RF emissions CISPR 11	Class A	This system is suitable for use in all establishments other than domestic and those directly connected to the public low-voltage power supply network that supplies buildings used for domestic purposes.
Harmonic emissions IEC 61000-3-2	Not applicable	
Voltage fluctuations / Flicker emissions IEC 61000-3-3	Not applicable	

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Guidance and manufacturer's declaration – electromagnetic immunity

This system is intended for use in the electromagnetic environment specified below. The customer or the user of this system should assure that it is used in such an environment.

Immunity test	IEC 60601 test level	Compliance level	Electromagnetic environment – guidance (advise especially if compliance is not met)
Electrostatic discharge (ESD) IEC 61000-4-2	±6 kV contact ±8 kV air	±6 kV contact ±8 kV air	Floors should be wood, concrete or ceramic tile. If floors are covered with synthetic material, the relative humidity should be at least 30%.
Electrical fast transient/burst IEC 61000-4-4	±2 kV for power supply lines ±1 kV for input/ output lines	±2 kV for power supply lines n.a.	Mains power quality should be that of a typical commercial or hospital environment.
Surge IEC 61000-4-5	±1 kV differential mode ±2 kV common mode	±1 kV differential mode ±2 kV common mode	Mains power quality should be that of a typical commercial or hospital environment.
Voltage dips, short interruptions and voltage variations on power supply input lines IEC 61000-4-11	<5% U_T (>95% dip in U_T) for 0.5 cycle 40% U_T (60% dip in U_T) for 5 cycles 70% U_T (30% dip in U_T) for 25 cycles <5% U_T (>95% dip in U_T) for 5 s	<5% U_T (>95% dip in U_T) for 0.5 cycle 40% U_T (60% dip in U_T) for 5 cycles 70% U_T (30% dip in U_T) for 25 cycles <5% U_T (>95% dip in U_T) for 5 s	Mains power quality should be that of a typical commercial or hospital environment.
Power frequency (50 Hz/60 Hz) magnetic field IEC 6100-4-8	3 A/m	3 A/m	Power frequency magnetic fields should be at levels characteristic of a typical location in a typical commercial or hospital environment.

Note: U_T is the AC mains voltage prior to application of the test level.

Guidance and manufacturer's declaration – electromagnetic immunity

This system is intended for use in the electromagnetic environment specified below. The customer or the user of this system should assure that it is used in such an environment.

Immunity test	IEC 60601 test level	Compliance level	Electromagnetic environment – guidance (advise especially if compliance is not met)
Radiated RF IEC 61000-4-3	3 V/m 150 kHz to 2.5 GHz	3 V/m 10 V/m	Portable and mobile RF communications equipment should be used no closer to any part of this system, including cables, than the recommended separation distance calculated from the equation applicable to the frequency of the transmitter. Recommended separation distance d = [3.5 / 3] √ P 150 kHz to 800 MHz d = [7 / 3] √ P 800 MHz to 2.5 GHz where P is the maximum output power rating of the transmitter in watts [W] according to the transmitter manufacturer and d is the recommended separation distance in metres [m]. Field strengths from fixed RF transmitters, as determined by an electromagnetic site survey [a], should be less than the compliance level in each frequency range [b]. Interference may occur in the vicinity of equipment marked with the following symbol:

Note 1 At 80 MHz and 800 MHz, the higher frequency range applies.

Note 2 These guidelines may not apply in all situations. Electromagnetic propagation is affected by absorption and reflection from structures, objects and people.

[a] Field strengths from fixed transmitters, such as base stations for radio (cellular/cordless) telephones and land mobile radios, amateur radio, AM and FM radio broadcast and TV broadcast cannot be predicted theoretically with accuracy. To assess the electromagnetic environment due to fixed RF transmitters, an electromagnetic site survey should be considered. If the measured field strength in the location in which this system is used exceeds the applicable RF compliance level above, this system should be observed to verify normal operation. If abnormal performance is observed, additional measures may be necessary, such as reorienting or relocating this system.

[b] Over the frequency range 150 kHz to 80 MHz, field strengths should be less than 10 V/m.

6.8 Type number plate

All labels are located on a label bracket at the top left corner of the front side of the cabinet, visibly marked by (for information).

If you swivel the label bracket 90° to the right the following labels will appear at its bottom side:

- X-RAY CONTROL (control unit) with indication of power class, serial number, type number and the name and the address of the manufacturer

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- X-RAY H.V. GENERATOR (high-voltage generator) with indication of power class, type number, serial number and the name and address of the manufacturer
- Technical data label
- Date of manufacture
- Certification label.

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7 Appendix

7.1 Error messages

Text	Meaning	Action
Door open	The door to the examination room is not closed.	Close door
XXXX Press RESET	This message appears if, for example, there are mains voltage fluctuations. The error code XXXX is intended for Customer Service.	Clear message: press Reset. The generator is ready for operation.
03HJ Press RESET	The focal spot selected has failed. You can proceed using a different focal spot.	Press Reset
Press power on	Initialisation phase has been disrupted.	Press again
15LH	During startup the footswitch has been pressed.	Do not press the footswitch during startup.

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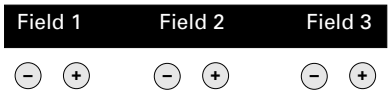
7.2 The hierarchy of levels on the display

There is more information than the display can give at a single level. The information which is not visible is filed in three further levels and can be displayed with . Each time you press the button you call up the next level. After level 4, level 1 reappears. If after an error message you have switched the generator off and back on again, you can call up this error message on level 4.

The following table tells you where you can find the several information:

Exposure techniques	Field*	Display on level 1	Display on level 2	Display on level 3	Display on level 4
with Automatic Exposure Control	1	kV	kV	1)	Message
	2	Density correction	mAs or mA (post-exp. display)		Message
	3	Screen-film combination	s (post-exp. display)		Message
kV-mAs	1	kV	kV	1)	Message
	2	mAs	mA (calculated)		Message
	3	s	2)		Message
kV-mAs-s	1	kV	kV	1)	Message
	2	mAs	mA (calculated)		Message
	3	s	2)		Message
kV-mA-s	1	kV	kV	1)	Message
	2	mA	mAs (calculated)		Message
	3	s	2)		Message
TDC	1	kV	kV	1)	Message
	2	Density correction	mAs or mA (post-exp. display)		Message
	3	Screen-film combination	s (programmed)		Message

* 

1) Total area of dose products (optional) in cGycm^2 per examination room and patient

2) The recommended screen-film combination is displayed. You cannot change the value. Apart from the precalculated value you can set all the values on the control desk.

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7.3 Screen-film combinations

Philips suggests the following designations:
- G200ST
- U400SP
- B100HR
- G200+–

Meaning of the abbreviations:
- G: Green
- U: Ultraviolet
- B: Blue
- ST: Standard
- SP: Special
- HR: High resolution
- +–: Graduated intensifying screen
- 100 … 400: Absolute screen speed

If required the Customer Service can programme different names (6 characters max.).

7.4 Key symbols and their meanings

The symbols on the buttons can be exchanged by Customer Service if required.

Symbol	Meaning
	Horizontal radiographic device
	Tiltable examination device with overtable cassette
	Angiography and Puck
	Tiltable examination device with undertable tube assembly and cassette
	Tomography device
	Fluoroscopy table with undertable tube assembly and image intensifier
	Tiltable examination device with undertable tube assembly and image intensifier
	Spot-film device
	Spot-film device, tomography
	DSI
	DSI, tomography
	Show vessels
	Fluoroscopy
	Bolus chase in lower extremities
	Skull unit
	Kymography
	Free cassette, room 2
	Wall column, room 2

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7.5 Exposure table

Part of body	Cassette size	cm	kV	mAs	AMPL. ○○○	SID [cm]	Focus ▪■■	SC [DIN]	Grid
Skull and trunk									
Zygo. arch., Henkeltopf	18 x 24	20	73	8		110	▪	200	+
Skulll ap/pa	24 x 30	20	77	16	○	110	▪	400	+
Skull lateral	24 x 30	16	73	8	○	110	▪	400	+
Clementschisch/Towne	24 x 30 (18 x 24 quer)	26	81	25	○	110	▪	400	+
Schüller/Stenvers	13 x 18	24	77	25	○	110	▪	400	+
Rheese/Orbita	13 x 18	19	73	16	○	110	▪	400	+
Pyramis comparison	13 x 18	22	77	16	○	110	▪	400	+
Skull axial	24 x 30	28	85	32	○	110	▪	400	+
Paranasal sinuses, semiaxial	18 x 24 (13 x 18)	22	77	40	○	110	▪	400	
Nasal bone	13 x 18	3	44	2.5		110	▪	200	+
Cervical spine ap	18 x 24	10	66	25	○	110	▪	400	+
Cervical spine lateral/oblique	18 x 24	12	73	25	○	150	▪	400	+
Dorsal spine ap (- +)	20 x 40 (18 x 43)	21	77	25	○	110	■	400	+
Dorsal spine lateral (+ -)/(+ - +)	20 x 40 (18 x 43)	32	81-85	40	○	110	■	400	+
Lumbar spine ap	20 x 40 (18 x 43)	22	77	25	○	110	■	400	+
Lumbar spine lateral (- +)/obl.	20 x 40 (18 x 43)	36	90-96	32	○	110	■	400	+
Sacrum lateral	18 x 24 (13 x 18)	28	90	40	○	110	■	400	+
Hip ap	24 x 30	20	77	20	○	110	■	400	+
Hip axial/Lauenstein	24 x 30	22	77	25	○	110	■	400	+
Ala-/obturatum exposure	24 x 30	24	77	25	○	110	■	400	+
Sacro iliac joint	18 x 24	22	81	20	○	110	■	400	+
Pelvis ap	35 x 43 (30 x 40)	20	77-85	12.5	○ ○	110	■	400	+
Thorax pa	35 x 35 (40 x 40)	18	125	2	○ ○	180	▪	400	+
Thorax lateral	35 x 35 (40 x 40)	26	125	3.2	○	180	■	200	+
Thorax recumbent (bed)	35 x 35 (40 x 40)	21	102	1		110	▪	400	
Ribs 1-7	30 x 40 (24 x 30)	16	66	20	○	110	▪	400	+
Ribs 8-12	30 x 40 (24 x 30)	20	77	16	○	110	■	400	+

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Part of body	Cassette size	cm	kV	mAs	AMPL.	SID [cm]	Focus	SC [DIN]	Grid
Abdomen									
Oesophagus	24 x 30		90		○		■	400	+
Stomach	35 x 35		102		○		■	400	+
Stomach detail	24 x 30 (18 x 24)		117		○		■	400	+
Small intestine (Sellink)	35 x 35 (24 x 30)		109		○		■	400	+
Colon	35 x 35		117		○○○	150	■	400	+
Colon			109		○		■	400	+
Colon detail	24 x 30 (18 x 24)		125		○		■	400	+
Abdomen	35 x 43 (30 x 40)		85		○○○		■	400	+
Abdomen side pos.	35 x 43 (30 x 40)		90-102		○		■	400	+
Kidneys empty	35 x 43 (30 x 40)		77		○		■	400	+
Kidneys + contrast medium	35 x 43 (30 x 40)		85		○		■	400	+
Kidneys detail	24 x 30		81		○		■	400	+
Ureter	20 x 40 (24 x 30)		77		○		■	400	+
Urethra	18 x 24		73		○		■	400	+
Bladder ap	18 x 24		77		○		■	400	+
Bladder lateral	18 x 24		90		○		■	400	+
Gallbladder empty	24 x 30 (18 x 24)		70		○		■	400	+
Gallbladder + contrast medium	24 x 30 (18 x 24)		77-85		○		■	400	+
Gallbladder detail	18 x 24		73		○		■	400	+
Phlebographies									
Pelvis	35 x 35 divid. in 3		77		○		■	400	+
Femur	35 x 35 divid. in 3		73		○		■	400	+
Lower leg	35 x 35 divid. in 3		66		○		■	400	+

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Part of body	Cassette size	cm	kV	mAs	AMPL. ○○○	SID [cm]	Focus ▪■■	SC [DIN]	Grid
Upper extremities									
Finger	13 x 18	1.5	46	2		110	▪	200	
Thumb	13 x 18	3	46	3.2		110	▪	200	
Hand ap	18 x 24	3	46	3.2		110	▪	200	
Hand (zither player)	18 x 24	4	48	3.2		110	▪	200	
Wrist ap	18 x 24 divid. in 2	5	48	4		110	▪	200	
Wrist lateral	18 x 24 divid. in 2	6	50	4		110	▪	200	
Navicular series ap/obl./lat.	24 x 30 or 18 x 24 divid. in 4	6-7	50	3.2-5		110	▪	200	
Forearm + wrist ap	18 x 24	7	52	4		110	▪	200	
Forearm + wrist lateral	18 x 24	8	52	5		110	▪	200	
Forearm + elbow ap	24 x 30 (18 x 24)	8	55	4		110	▪	200	
Forearm + elbow lateral	24 x 30 (18 x 24)	9	55	5		110	▪	200	
Elbow ap	18 x 24	9	55	5		110	▪	200	
Elbow lateral	18 x 24	10	55	6.4		110	▪	200	
Humerus + elbow ap	24 x 30 divid. in 2	11	60	6.4		110	▪	200	
Humerus + elbow lateral	24 x 30 divid. in 2	12	60	6.4		110	▪	200	
Humerus + shoulder ap	24 x 30 (18 x 24)	13	66	10	○	110	▪	200	+
Humerus + shoulder lateral	24 x 30 (18 x 24)	13	66	12	○	110	▪	200	+
Shoulder ap	18 x 24	16	66	32	○	110	▪	200	+
Shoulder axial	18 x 24	16	66	32	○	110	▪	200	+
Shoulder transthoracal	18 x 24	26	85/90	25	○	110	■	200	+
Clavicle	18 x 24	14	66	10	○	110	▪	200	+
Sternum lateral	24 x 30	42	85	8	○	110	■	200	+
Sternum oblique	24 x 30	21	77	16	○	110	■	200	+
Scapula ap	18 x 24	17	70	10	○	110	▪	200	+

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Part of body	Cassette size	cm	kV	mAs	AMPL. ○○○	SID [cm]	Focus ▪■■	SC [DIN]	Grid
Lower extremities									
Toes	18 x 24 (13 x 18)	2	46	2.5		110	▪	200	
Forefoot ap	18 x 24	3	48	2.5		110	▪	200	
Forefoot oblique	18 x 24	4	48	3.2		110	▪	200	
Foot ap	18 x 24	5	50	3.2		110	▪	200	
Foot oblique	18 x 24	6	50	5		110	▪	200	
Lower ankle ap	18 x 24 divid. in 2	9	55	5		110	▪	200	
Lower ankle oblique	18 x 24 divid. in 2	7	52	4		110	▪	200	
Upper ankle ap	18 x 24 divid. in 2	9	55	5		110	▪	200	
Upper ankle lateral	18 x 24 divid. in 2	8	55	4		110	▪	200	
Calcaneum axial	18 x 24 divid. in 2	11	55	6.4		110	▪	200	
Calcaneum lateral	18 x 24 divid. in 2	8	52	4		110	▪	200	
Lower leg + upper ankle ap	20 x 40	9	57	4		110	▪	200	
Lower leg + upper ankle lateral	20 x 40	8	57	3.2		110	▪	200	
Lower leg + knee ap	20 x 40	11	60	5		110	▪	200	
Lower leg + knee lateral	20 x 40	10	60	4		110	▪	200	
Knee ap	18 x 24	11	66	5	○	110	▪	200	+
Knee lateral	18 x 24	10	66	4	○	110	▪	200	+
Patella axial + Défilé	13 x 18	12	63	8		110	▪	200	
Frik	13 x 18 or 18 x 24 special cassette	13	63	10		110	▪	200	
Femur + knee ap/lateral	20 x 40	14	66	2	○	110	▪	200	+
Femur + hip ap	20 x 40	16	73	20	○	110	■	400	+
Femur + hip lateral	20 x 40	16	73	25	○	110	■	400	+
Hip ap	24 x 30	20	77	20	○	110	■	400	+
Hip Sven Johansson	24 x 30	20	81	10		110	■	400	
Hip axial/Lauenstein	24 x 30	22	77	25	○	110	■	400	+
Pelvis ap	35 x 43 (30 x 40)	20	77-85	12.5	○ ○	110	■	400	+

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7.6 Abbreviations and their meanings

Abbreviation	Meaning
AEC	Automatic Exposure Control
APR	Anatomically Programmed Radiography
APRF	Anatomisch programmierte Radiographie and Fluoroscopy
DSI	Digital Spot Imaging
f/min	Frames per minute
II	Image intensifier
PDO	Patient Data Organizer
SFC	Screen-film combination
SID	Source-Image distance
TDC	Tomography Density Control

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